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Complexity and Collapse

Empires on the Edge of Chaos

Niall Ferguson

THERE IS no better illustration of the life cycle of a great power than *The Course of Empire*, a series of five paintings by Thomas Cole that hang in the New-York Historical Society. Cole was a founder of the Hudson River School and one of the pioneers of nineteenth-century American landscape painting; in *The Course of Empire*, he beautifully captured a theory of imperial rise and fall to which most people remain in thrall to this day.

Each of the five imagined scenes depicts the mouth of a great river beneath a rocky outcrop. In the first, *The Savage State*, a lush wilderness is populated by a handful of hunter-gatherers eking out a primitive existence at the break of a stormy dawn. The second picture, *The Arcadian or Pastoral State*, is of an agrarian idyll: the inhabitants have cleared the trees, planted fields, and built an elegant Greek temple. The third and largest of the paintings is *The Consummation of Empire*. Now, the landscape is covered by a magnificent marble entrepôt, and the contented farmer-philosophers of the previous tableau have been replaced by a throng of opulently clad merchants, proconsuls, and citizen-consumers. It is midday in the life cycle. Then comes *Destruction*. The

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city is ablaze, its citizens fleeing an invading horde that rapes and pillages beneath a brooding evening sky. Finally, the moon rises over the fifth painting, *Desolation*. There is not a living soul to be seen, only a few decaying columns and colonnades overgrown by briars and ivy.

Conceived in the mid-1830s, Cole's great pentaptych has a clear message: all empires, no matter how magnificent, are condemned to decline and fall. The implicit suggestion was that the young American republic of Cole's age would be better served by sticking to its bucolic first principles and resisting the imperial temptations of commerce, conquest, and colonization.

For centuries, historians, political theorists, anthropologists, and the public at large have tended to think about empires in such cyclical and gradual terms. "The best instituted governments," the British political philosopher Henry St. John, First Viscount Bolingbroke, wrote in 1738, "carry in them the seeds of their destruction: and, though they grow and improve for a time, they will soon tend visibly to their dissolution. Every hour they live is an hour the less that they have to live."

Idealists and materialists alike have shared that assumption. In his book *Scienza nuova*, the Italian philosopher Giambattista Vico describes all civilizations as passing through three phases: the divine, the heroic, and the human, finally dissolving into what Vico called "the barbarism of reflection." For Hegel and Marx, it was the dialectic that gave history its unmistakable beat. History was seasonal for Oswald Spengler, the German historian, who wrote in his 1918–22 book, *The Decline of the West*, that the nineteenth century had been "the winter of the West, the victory of materialism and skepticism, of socialism, parliamentarianism, and money." The British historian Arnold Toynbee's universal theory of civilization proposed a cycle of challenge, response, and suicide. Each of these models is different, but all share the idea that history has rhythm.

Although hardly anyone reads Spengler or Toynbee today, similar strains of thought are visible in contemporary bestsellers. Paul Kennedy's *The Rise and Fall of the Great Powers* is another work of cyclical history—despite its profusion of statistical tables, which at first sight make it seem the very antithesis of Spenglerian grand theory. In Kennedy's model, great powers rise and fall according to the growth rates of their

industrial bases and the costs of their imperial commitments relative to their GDPs. Just as in Cole's *The Course of Empire*, imperial expansion carries the seeds of future decline. As Kennedy writes, "If a state overextends itself strategically . . . it runs the risk that the potential benefits from external expansion may be outweighed by the great expense of it all." This phenomenon of "imperial overstretch," Kennedy argues, is common to all great powers. In 1987, when Kennedy's book was published, the United States worried that it might be succumbing to this disease. Just because the Soviet Union fell first did not necessarily invalidate the hypothesis.

More recently, it is Jared Diamond, an anthropologist, who has captured the public imagination with a grand theory of rise and fall. His 2005 book, *Collapse: How Societies Choose to Fail or Succeed*, is cyclical history for the so-called Green Age: tales of past societies, from seventeenth-century Easter Island to twenty-first-century China, that risked, or now risk, destroying themselves by abusing their natural environments. Diamond quotes John Lloyd Stevens, the American explorer and amateur archaeologist who discovered the eerily dead Mayan cities of Mexico: "Here were the remains of a cultivated, polished, and peculiar people, who had passed through all the stages incident to the rise and fall of nations, reached their golden age, and perished." According to Diamond, the Maya fell into a classic Malthusian trap as their population grew larger than their fragile and inefficient agricultural system could support. More people meant more cultivation, but more cultivation meant deforestation, erosion, drought, and soil exhaustion. The result was civil war over dwindling resources and, finally, collapse.

Diamond's warning is that today's world could go the way of the Maya. This is an important message, no doubt. But in reviving the cyclical theory of history, *Collapse* reproduces an old conceptual defect. Diamond makes the mistake of focusing on what historians of the French Annales school called *la longue durée*, the long term. No matter whether civilizations commit suicide culturally, economically, or ecologically, the downfall is very protracted. Just as it takes centuries for imperial overstretch to undermine a great power, so, too, does it take centuries to wreck an ecosystem. As Diamond points out, political leaders in almost any society—primitive or sophisticated—have little

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The Savage State, *from Thomas Cole's* The Course of Empire (1833–36)

incentive to address problems that are unlikely to manifest themselves for a hundred years or more.

Did the proconsuls in Cole's *The Consummation of Empire* really care if the fate of their great-great-grandchildren was destruction? No. Would they have accepted a tax increase that would have financed a preemptive strike against the next millennium's barbarian horde? Again, no. As the UN Climate Change Conference in Copenhagen last December made clear, rhetorical pleas to save the planet for future generations are insufficient to overcome the conflicts over economic distribution between rich and poor countries that exist in the here and now.

The current economic challenges facing the United States are also often represented as long-term threats. It is the slow march of demographics—which is driving up the ratio of retirees to workers—and not current policy, that condemns the public finances of the United States to sink deeper into the red. According to the Congressional Budget Office's "alternative fiscal scenario," which takes into account likely changes in government policy, public debt could rise from 44 percent before the financial crisis to a staggering 716 percent by 2080. In its "extended-baseline scenario," which assumes current policies will remain the same, the figure is closer to 280 percent. It hardly seems

to matter which number is correct. Is there a single member of Congress who is willing to cut entitlements or increase taxes in order to avert a crisis that will culminate only when today's babies are retirees?

Similarly, when it comes to the global economy, the wheel of history seems to revolve slowly, like an old water mill in high summer. Some projections suggest that China's GDP will overtake the United States' GDP in 2027; others say that this will not happen until 2040. By 2050, India's economy will supposedly catch up with that of the United States, too. But to many, these great changes in the balance of economic power seem very remote compared with the timeframe for the deployment of U.S. soldiers to Afghanistan and then their withdrawal, for which the unit of account is months, not years, much less decades.

Yet it is possible that this whole conceptual framework is, in fact, flawed. Perhaps Cole's artistic representation of imperial birth, growth, and eventual death is a misrepresentation of the historical process. What if history is not cyclical and slow moving but arrhythmic—at times almost stationary, but also capable of accelerating suddenly, like a sports car? What if collapse does not arrive over a number of centuries but comes suddenly, like a thief in the night?

WHEN GOOD SYSTEMS GO BAD

GREAT POWERS and empires are, I would suggest, complex systems, made up of a very large number of interacting components that are asymmetrically organized, which means their construction more resembles a termite hill than an Egyptian pyramid. They operate somewhere between order and disorder—on "the edge of chaos," in the phrase of the computer scientist Christopher Langton. Such systems can appear to operate quite stably for some time; they seem to be in equilibrium but are, in fact, constantly adapting. But there comes a moment when complex systems "go critical." A very small trigger can set off a "phase transition" from a benign equilibrium to a crisis—a single grain of sand causes a whole pile to collapse, or a butterfly flaps its wings in the Amazon and brings about a hurricane in southeastern England.

Not long after such crises happen, historians arrive on the scene. They are the scholars who specialize in the study of "fat tail" events—the low-frequency, high-impact moments that inhabit the tails of

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The Arcadian or Pastoral State, *from Thomas Cole's* The Course of Empire (1833–36)

probability distributions, such as wars, revolutions, financial crashes, and imperial collapses. But historians often misunderstand complexity in decoding these events. They are trained to explain calamity in terms of long-term causes, often dating back decades. This is what Nassim Taleb rightly condemned in *The Black Swan* as "the narrative fallacy": the construction of psychologically satisfying stories on the principle of *post hoc, ergo propter hoc*.

Drawing casual inferences about causation is an age-old habit. Take World War I. A huge war breaks out in the summer of 1914, to the great surprise of nearly everyone. Before long, historians have devised a story line commensurate with the disaster: a treaty governing the neutrality of Belgium that was signed in 1839, the waning of Ottoman power in the Balkans dating back to the 1870s, and malevolent Germans and the navy they began building in 1897. A contemporary version of this fallacy traces the 9/11 attacks back to the Egyptian government's 1966 execution of Sayyid Qutb, the Islamist writer who inspired the Muslim Brotherhood. Most recently, the financial crisis that began in 2007 has been attributed to measures of financial deregulation taken in the United States in the 1980s.

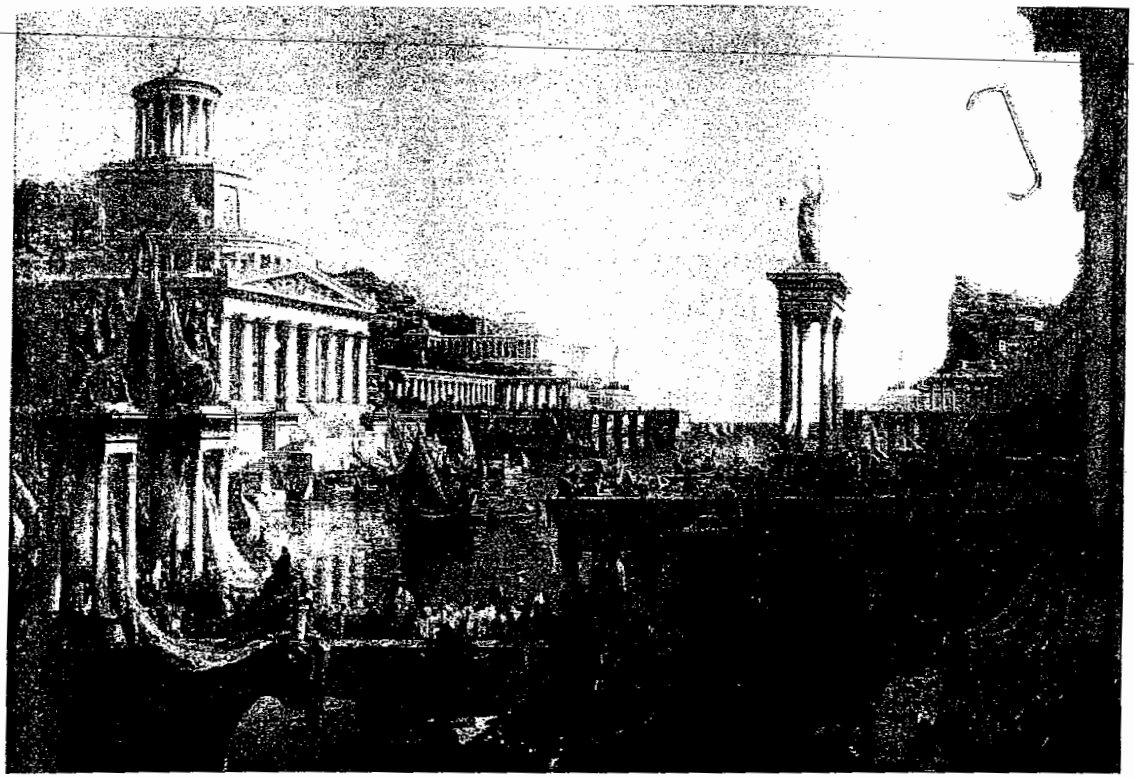
In reality, the proximate triggers of a crisis are often sufficient to explain the sudden shift from a good equilibrium to a bad mess. Thus,

World War I was actually caused by a series of diplomatic miscalculations in the summer of 1914, the real origins of 9/11 lie in the politics of Saudi Arabia in the 1990s, and the financial crisis was principally due to errors in monetary policy by the U.S. Federal Reserve and to China's rapid accumulation of dollar reserves after 2001. Most of the fat-tail phenomena that historians study are not the climaxes of prolonged and deterministic story lines; instead, they represent perturbations, and sometimes the complete breakdowns, of complex systems.

To understand complexity, it is helpful to examine how natural scientists use the concept. Think of the spontaneous organization of half a million ants or termites, which allows them to construct complex hills and nests, or the fractal geometry of water molecules as they form intricate snowflakes. Human intelligence itself is a complex system, a product of the interaction of billions of neurons in the central nervous system, or what Charles Sherrington, the pioneering neuroscientist, called "an enchanted loom."

The political and economic structures made by humans share many of the features of complex adaptive systems. Heterodox economists such as W. Brian Arthur have been arguing along these lines for decades. To Arthur, a complex economy is characterized by the interaction of dispersed agents, a lack of central control, multiple levels of organization, continual adaptation, incessant creation of new market niches, and the absence of general equilibrium. This conception of economics goes beyond both Adam Smith's hallowed idea that an "invisible hand" causes markets to work through the interactions of profit-maximizing individuals and Friedrich von Hayek's critique of economic planning and demand management. In contradiction to the classic economic prediction that competition causes diminishing returns, a complex economy makes increasing returns possible. In this version of economics, Silicon Valley is a complex adaptive system; so is the Internet itself.

Researchers at the Santa Fe Institute, a nonprofit center devoted to the study of complex systems, are currently looking at how such insights can be applied to other aspects of collective human activity, including international relations. This effort may recall the futile struggle of Edward Casaubon to find "the key to all mythologies" in George Eliot's novel *Middlemarch*. But the attempt is worthwhile,



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The Consummation of Empire, *from Thomas Cole's* The Course of Empire (1833–36)

because an understanding of how complex systems function is an essential part of any strategy to anticipate and delay their failure.

Whether the canopy of a rain forest or the trading floor of Wall Street, complex systems share certain characteristics. A small input to such a system can produce huge, often unanticipated changes—what scientists call "the amplifier effect." A vaccine, for example, stimulates the immune system to become resistant to, say, measles or mumps. But administer too large a dose, and the patient dies. Meanwhile, causal relationships are often nonlinear, which means that traditional methods of generalizing through observation (such as trend analysis and sampling) are of little use. Some theorists of complexity would go so far as to say that complex systems are wholly nondeterministic, meaning that it is impossible to make predictions about their future behavior based on existing data.

When things go wrong in a complex system, the scale of disruption is nearly impossible to anticipate. There is no such thing as a typical

or average forest fire, for example. To use the jargon of modern physics, a forest before a fire is in a state of "self-organized criticality": it is teetering on the verge of a breakdown, but the size of the breakdown is unknown. Will there be a small fire or a huge one? It is very hard to say: a forest fire twice as large as last year's is roughly four or six or eight times less likely to happen this year. This kind of pattern—known as a "power-law distribution"—is remarkably common in the natural world. It can be seen not just in forest fires but also in earthquakes and epidemics. Some researchers claim that conflicts follow a similar pattern, ranging from local skirmishes to full-scale world wars.

What matters most is that in such systems a relatively minor shock can cause a disproportionate—and sometimes fatal—disruption. As Taleb has argued, by 2007, the global economy had grown to resemble an over-optimized electrical grid. Defaults on subprime mortgages produced a relatively small surge in the United States that tipped the entire world economy into a financial blackout, which, for a moment, threatened to bring about a complete collapse of international trade. But blaming such a crash on a policy of deregulation under U.S. President Ronald Reagan is about as plausible as blaming World War I on the buildup of the German navy under Admiral Alfred von Tirpitz.

EMPIRE STATE OF MIND

REGARDLESS OF whether it is a dictatorship or a democracy, any large-scale political unit is a complex system. Most great empires have a nominal central authority—either a hereditary emperor or an elected president—but in practice the power of any individual ruler is a function of the network of economic, social, and political relations over which he or she presides. As such, empires exhibit many of the characteristics of other complex adaptive systems—including the tendency to move from stability to instability quite suddenly. But this fact is rarely recognized because of the collective addiction to cyclical theories of history.

Perhaps the most famous story of imperial decline is that of ancient Rome. In *The History of the Decline and Fall of the Roman Empire*, published in six volumes between 1776 and 1788, Edward Gibbon covered

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Destruction, *from Thomas Cole's* The Course of Empire (1833–36)

more than 1,400 years of history, from 180 to 1590. This was history over the very long run, in which the causes of decline ranged from the personality disorders of individual emperors to the power of the Praetorian Guard and the rise of monotheism. After the death of Marcus Aurelius in 180, civil war became a recurring problem, as aspiring emperors competed for the spoils of supreme power. By the fourth century, barbarian invasions or migrations were well under way and only intensified as the Huns moved west. Meanwhile, the challenge posed by Sassanid Persia to the Eastern Roman Empire was steadily growing.

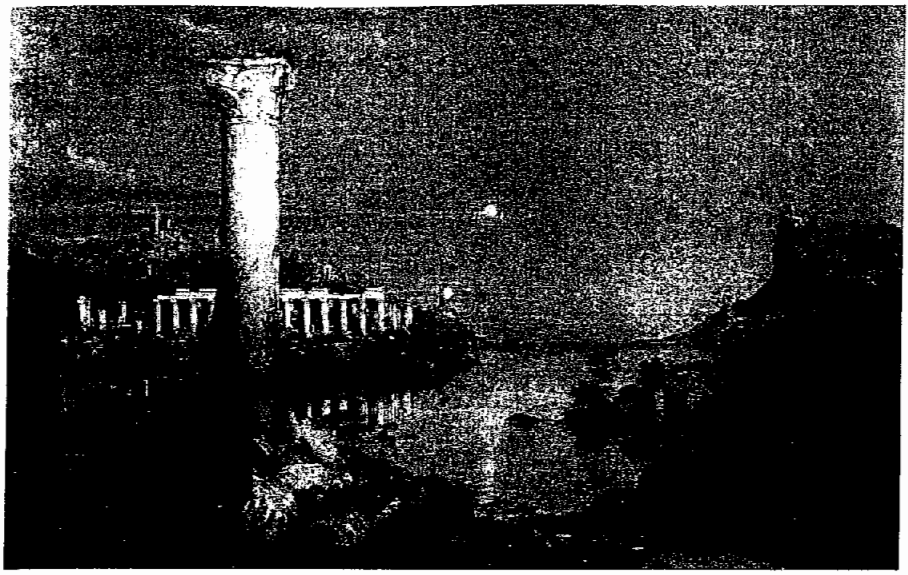
But what if fourth-century Rome was simply functioning normally as a complex adaptive system, with political strife, barbarian migration, and imperial rivalry all just integral features of late antiquity? Through this lens, Rome's fall was sudden and dramatic—just as one would expect when such a system goes critical. As the Oxford historians Peter Heather and Bryan Ward-Perkins have argued, the final breakdown in the Western Roman Empire began in 406, when Germanic invaders poured across the Rhine into Gaul and then Italy. Rome itself was sacked by the Goths in 410. Co-opted by an enfeebled emperor, the Goths then fought the Vandals for control of Spain, but this merely shifted the problem south. Between 429 and 439, Genseric led the Vandals to victory after victory in North Africa, culminating in

the fall of Carthage. Rome lost its southern Mediterranean breadbasket and, along with it, a huge source of tax revenue. Roman soldiers were just barely able to defeat Attila's Huns as they swept west from the Balkans. By 452, the Western Roman Empire had lost all of Britain, most of Spain, the richest provinces of North Africa, and southwestern and southeastern Gaul. Not much was left besides Italy. Basiliscus, brother-in-law of Emperor Leo I, tried and failed to recapture Carthage in 468. Byzantium lived on, but the Western Roman Empire was dead. By 476, Rome was the fiefdom of Odoacer, king of the Goths.

What is most striking about this history is the speed of the Roman Empire's collapse. In just five decades, the population of Rome itself fell by three-quarters. Archaeological evidence from the late fifth century—inferior housing, more primitive pottery, fewer coins, smaller cattle—shows that the benign influence of Rome diminished rapidly in the rest of western Europe. What Ward-Perkins calls "the end of civilization" came within the span of a single generation.

Other great empires have suffered comparably swift collapses. The Ming dynasty in China began in 1368, when the warlord Zhu Yuanzhang renamed himself Emperor Hongwu, the word *hongwu* meaning "vast military power." For most of the next three centuries, Ming China was the world's most sophisticated civilization by almost any measure. Then, in the mid-seventeenth century, political factionalism, fiscal crisis, famine, and epidemic disease opened the door to rebellion within and incursions from without. In 1636, the Manchu leader Huang Taiji proclaimed the advent of the Qing dynasty. Just eight years later, Beijing, the magnificent Ming capital, fell to the rebel leader Li Zicheng, and the last Ming emperor hanged himself out of shame. The transition from Confucian equipoise to anarchy took little more than a decade.

In much the same way, the Bourbon monarchy in France passed from triumph to terror with astonishing rapidity. French intervention on the side of the colonial rebels against British rule in North America in the 1770s seemed like a good idea at the time—a chance for revenge after Great Britain's victory in the Seven Years' War a decade earlier—but it served to tip French finances into a critical state. In May 1789, the summoning of the Estates-General, France's long-dormant representative assembly, unleashed a political chain reaction that led to



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Desolation, *from Thomas Cole's* The Course of Empire (1833–36)

a swift collapse of royal legitimacy in France. Only four years later, in January 1793, Louis XVI was decapitated by guillotine.

Although several narrative fallacies suggest that the Hapsburg, Ottoman, and Romanov empires were doomed for decades before World War I, the disintegration of the dynastic land empires of eastern Europe came with equal swiftness. What was impressive, in fact, was how well these ancient empires were able to withstand the test of total war. Their collapse only began with the Bolshevik Revolution of October 1917. A mere five years later, Mehmed VI, the last sultan of the Ottoman Empire, departed Constantinople aboard a British warship. With that, all three dynasties were defunct.

The sun set on the British Empire almost as suddenly. In February 1945, Prime Minister Winston Churchill was at Yalta, dividing up the world with U.S. President Franklin Roosevelt and Soviet Premier Joseph Stalin. As World War II was ending, he was swept from office in the July 1945 general election. Within a decade, the United Kingdom had conceded independence to Bangladesh, Bhutan, Burma, Egypt, Eritrea, India, Iran, Israel, Jordan, Libya, Madagascar, Pakistan, and Sri Lanka. The Suez crisis in 1956 proved that the United Kingdom could not act in defiance of the United States in the Middle East, setting the seal on the end of empire. Although it took until the 1960s

for independence to reach sub-Saharan Africa and the remnants of colonial rule east of the Suez, the United Kingdom's age of hegemony was effectively over less than a dozen years after its victories over Germany and Japan.

The most recent and familiar example of precipitous decline is, of course, the collapse of the Soviet Union. With the benefit of hindsight, historians have traced all kinds of rot within the Soviet system back to the Brezhnev era and beyond. Perhaps, as the historian and political scientist Stephen Kotkin has argued, it was only the high oil prices of the 1970s that "averted Armageddon." But this did not seem to be the case at the time. In March 1985, when Mikhail Gorbachev became general secretary of the Soviet Communist Party, the CIA estimated the Soviet economy to be approximately 60 percent the size of the U.S. economy. This estimate is now known to have been wrong, but the Soviet nuclear arsenal was genuinely larger than the U.S. stockpile. And governments in what was then called the Third World, from Vietnam to Nicaragua, had been tilting in the Soviets' favor for most of the previous 20 years. Yet less than five years after Gorbachev took power, the Soviet imperium in central and Eastern Europe had fallen apart, followed by the Soviet Union itself in 1991. If ever an empire fell off a cliff—rather than gently declining—it was the one founded by Lenin.

OVER THE EDGE

IF EMPIRES are complex systems that sooner or later succumb to sudden and catastrophic malfunctions, rather than cycling sedately from Arcadia to Apogee to Armageddon, what are the implications for the United States today? First, debating the stages of decline may be a waste of time—it is a precipitous and unexpected fall that should most concern policymakers and citizens. Second, most imperial falls are associated with fiscal crises. All the above cases were marked by sharp imbalances between revenues and expenditures, as well as difficulties with financing public debt. Alarm bells should therefore be ringing very loudly, indeed, as the United States contemplates a deficit for 2009 of more than $1.4 trillion—about 11.2 percent of GDP, the biggest deficit in 60 years—and another for 2010 that will not be

much smaller. Public debt, meanwhile, is set to more than double in the coming decade, from $5.8 trillion in 2008 to $14.3 trillion in 2019. Within the same timeframe, interest payments on that debt are forecast to leap from eight percent of federal revenues to 17 percent.

These numbers are bad, but in the realm of political entities, the role of perception is just as crucial, if not more so. In imperial crises, it is not the material underpinnings of power that really matter but expectations about future power. The fiscal numbers cited above cannot erode U.S. strength on their own, but they can work to weaken a long-assumed faith in the United States' ability to weather any crisis. For now, the world still expects the United States to muddle through, eventually confronting its problems when, as Churchill famously said, all the alternatives have been exhausted. Through this lens, past alarms about the deficit seem overblown, and 2080—when the U.S. debt may reach staggering proportions—seems a long way off, leaving plenty of time to plug the fiscal hole. But one day, a seemingly random piece of bad news—perhaps a negative report by a rating agency—will make the headlines during an otherwise quiet news cycle. Suddenly, it will be not just a few policy wonks who worry about the sustainability of U.S. fiscal policy but also the public at large, not to mention investors abroad. It is this shift that is crucial: a complex adaptive system is in big trouble when its component parts lose faith in its viability.

Over the last three years, the complex system of the global economy flipped from boom to bust—all because a bunch of Americans started to default on their subprime mortgages, thereby blowing huge holes in the business models of thousands of highly leveraged financial institutions. The next phase of the current crisis may begin when the public begins to reassess the credibility of the monetary and fiscal measures that the Obama administration has taken in response. Neither interest rates at zero nor fiscal stimulus can achieve a sustainable recovery if people in the United States and abroad collectively decide, overnight, that such measures will lead to much higher inflation rates or outright default. As Thomas Sargent, an economist who pioneered the idea of rational expectations, demonstrated more than 20 years ago, such decisions are self-fulfilling: it is not the base supply of money that determines inflation but the velocity of its circulation, which in turn is a function of expectations. In the same way, it is not the debt-to-

GDP ratio that determines government solvency but the interest rate that investors demand. Bond yields can shoot up if expectations change about future government solvency, intensifying an already bad fiscal crisis by driving up the cost of interest payments on new debt. Just ask Greece—it happened there at the end of last year, plunging the country into fiscal and political crisis.

Finally, a shift in expectations about monetary and fiscal policy could force a reassessment of future U.S. foreign policy. There is a zero-sum game at the heart of the budgetary process: if interest payments consume a rising proportion of tax revenue, military expenditure is the item most likely to be cut because, unlike mandatory entitlements, it is discretionary. A U.S. president who says he will deploy 30,000 additional troops to Afghanistan and then, in 18 months' time, start withdrawing them again already has something of a credibility problem. And what about the United States' other strategic challenges? For the United States' enemies in Iran and Iraq, it must be consoling to know that U.S. fiscal policy today is preprogrammed to reduce the resources available for all overseas military operations in the years ahead.

Defeat in the mountains of the Hindu Kush or on the plains of Mesopotamia has long been a harbinger of imperial fall. It is no coincidence that the Soviet Union withdrew from Afghanistan in the annus mirabilis of 1989. What happened 20 years ago, like the events of the distant fifth century, is a reminder that empires do not in fact appear, rise, reign, decline, and fall according to some recurrent and predictable life cycle. It is historians who retrospectively portray the process of imperial dissolution as slow-acting, with multiple overdetermining causes. Rather, empires behave like all complex adaptive systems. They function in apparent equilibrium for some unknowable period. And then, quite abruptly, they collapse. To return to the terminology of Thomas Cole, the painter of *The Course of Empire*, the shift from consummation to destruction and then to desolation is not cyclical. It is sudden.

A more appropriate visual representation of the way complex systems collapse may be the old poster, once so popular in thousands of college dorm rooms, of a runaway steam train that has crashed through the wall of a Victorian railway terminus and hit the street below nose first. A defective brake or a sleeping driver can be all it takes to go over the edge of chaos.